Tafkhim in Arabic: the Acoustic and Psychological Parameters

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1. Introduction

The phonetic phenomenon of 'tafkhim' (retraction) has been intensively investigated. As a categorical feature, tafkhim has been found to color any consonant or vowel, depending on the specific phonetic context.

The domain of distinctive features is considered one of the most important elements in the study of both phonetics and phonology. Accordingly, to describe a phonetic feature properly, is to delineate phonetic representations and behavior of linguistic sounds. It is apparent that the feature *retraction* is marked in the vowels by a definite raising of Formant one (F_1) and the lowering of Formant two (F_2). As for Formant three (F_3), it is used as a separate acoustic parameter for distinguishing some phonemes in the language.

2. Method

The method for obtaining the acoustic-phonetic results was determined through an experiment which was designed and carried out at the Phonetics Laboratory at Indiana University. A sequence of 220 utterances were read by a native speaker of Arabic from Alexandria, Egypt. The focus of the experiment was to investigate the unifying acoustic parameters of the Arabic consonants and vowels. The structure of each utterance of the data is the phonetic patterns /ʔ,VC,V/. Spectrograms were prepared of each utterance on a wide-band sound spectrogram machine (Voice Identification, Series 700). Measurements of the components of each utterance were made. The acoustic-phonetic cues of the vowels and consonants were measured and identified in the following manner.

3. Results

Vowel variable

The physical correlate of the retraction is manifested in the formants of the vowels with varying degrees. The vowel which shows the feature of retraction most significantly is /a/, and the least significant are the back vowels (See Fig. 1).

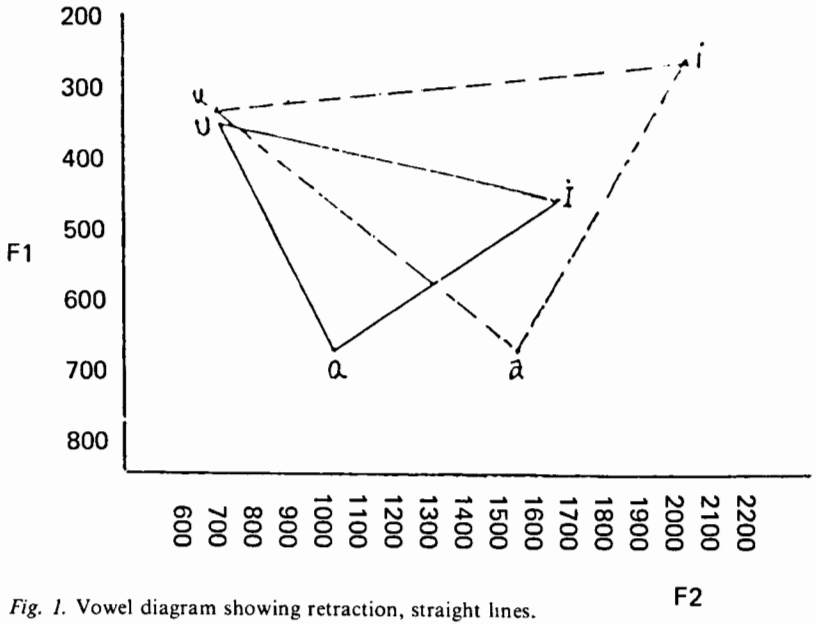


Fig. 1. Vowel diagram showing retraction, straight lines.

Formant variable

Both F_1 and F_2 possess a significant clue for the feature of retraction. But F_2 is not a consistent criterion since its significance fluctuates so that in some cases it is highly insignificant. (Consider the F-pattern in some phonetic classes of consonants in Figure 2).

Distance between formants

The F_2-F_1 difference is more significant than the F_3-F_2 difference. This is consistent with the weak significance of F_3 (See Tables I and II).

Table I. The mean measurements of vowels

	V_1												
	Onset		Steady		Offset			Onset		Steady		Offset	
	F_1	F_2	F_1	F_2	F_1	F_2		F_1	F_2	F_1	F_2	F_1	F_2
a	724	1581	743	1614	705	1655	ɑ	729	1029	736	1062	683	1060
i	269	2069	314	2086	314	2055	ɪ	457	1712	495	1667	469	1586
u	333	698	357	850	338	925	ʊ	348	706	371	867	338	945
	V_2												
a	681	1629	721	1602	693	1571	ɑ	598	1081	707	1038	710	962
i	302	2017	279	2081	224	2131	ɪ	426	1498	433	1631	360	1874
u	343	995	317	760	336	652	ʊ	305	960	310	771	350	625

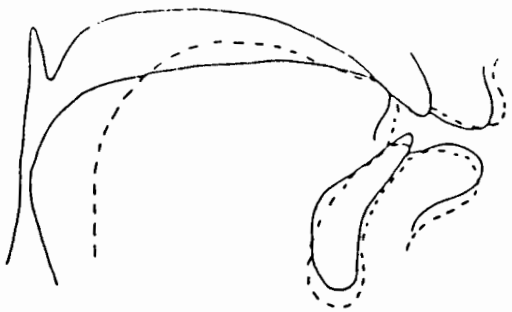
Table II.

FD_1 (F_2 - F_1)									
V_1			V_2						
	Mean	SD		Mean	SD		Mean	SD		Mean	SD
a	871	(114)	ɑ	326	(240)	a	881	(161)	ɑ	331	(224)
i	1771	(64)	ɪ	1171	(171)	i	1802	(150)	ɪ	1198	(246)
u	493	(121)	ʊ	495	(122)	u	443	(99)	ʊ	462	(112)
F = 246.67						F = 24.82					
FD_2 (F_3 - F_2)									
a	724	(971)	ɑ	1424	(189)	a	871	(781)	ɑ	1064	(947)
i	529	(68)	ɪ	757	(242)	i	526	(90)	ɪ	650	(524)
u	-283	(1122)	ʊ	-512	(788)	u	-62	(1095)	ʊ	2	(1292)
F = 10.42						F = 7.43					

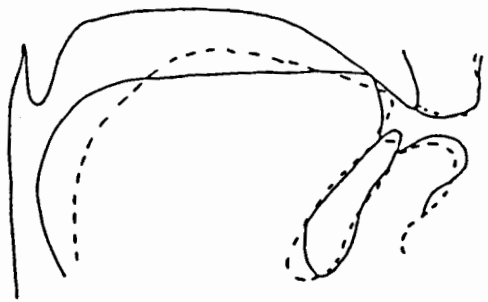
SD = Standard deviation; F = Fisher test.

With regard to the manifestation of retraction on segments, the vowels used in this study fall into two groups. The front vowel /i/ shows significant changes in quality as measured by first and second formant frequencies. The back vowel /u/ shows insignificant changes between the plain and retracted allophones. The compact vowel /a/ is the most significant as it enhances and demonstrates clearly the color of the feature of retraction. The acute consonants are the consonantal category which shows most significantly the color of the feature under discussion (compare Table I with Table II).

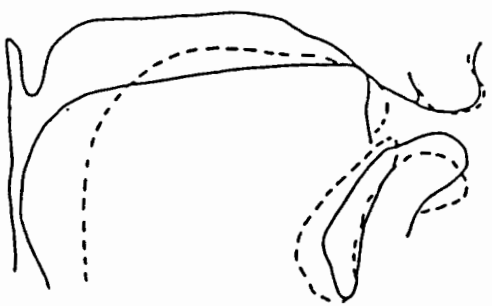
The physiological phonetic parameters of retraction have been examined. As they became evident through the observation of the production of sequences of utterances, it was noted that the utterances contained the four independent emphatic consonants. Their conditioning of the neighboring sounds, specifically the vowels, was the focus of investigation. An experiment was designed and its utterances were recorded on a sound X-ray film at the University of Iowa in the Department of Otolaryngology and Maxillofacial Surgery. Tracings of certain selected frames were made. These tracings show the various configurations of the tongue movements associated with the emphatic sounds. It was indicated that clear proof exists of the lowering of the body of the tongue which is simultaneously correlated with the retraction movement of the whole body of the tongue, especially its back (See Figs. 2a, 2b, 2c).



/t/ in /tu/ - - - -
/t̲/ in /t̲u/ ——



/t/ in /ti/ - - - -
/t̲/ in /t̲i/ ——



/t/ in /ta/ - - - -
/t̲/ in /t̲a/ ——

Fig. 2. Tongue movements compared in normal vs. emphatic articulation of /t/.

4. Conclusion

The acoustic phonetic results correlate and agree with the physiological findings concerning the description of the characteristics of the phenomena of retraction. The combined findings of the acoustical and physiological investigations gave clear proof of how the phenomena of 'tafkhim' operates in Arabic.

References

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